

REMARKS/ARGUMENTS

This amendment is filed with a request for continued examination rather than filing an appeal brief. The time for filing a paper further to the notice of appeal is extended by one month by the accompanying petition to October 16, the first business day following Saturday October 14, 2006. Pursuant to this amendment, claims 21-58 are pending. Reexamination and reconsideration are respectfully requested.

Section 112 Rejection

The final Office Action dated April 19, 2006 rejects claims 45 and 57 as lacking written description. Applicants respectfully traverse this rejection. Claims 45 and 57 are directed to similar subject matter and are amended to more exactly reflect the application language. Taking claim 45 as an example, the claim recites "The method of claim 21, further comprising depositing an insulating layer over the dielectric material without first performing a high temperature step on the dielectric material." The application provides a written description of this invention.

At page 8, lines 18-19, the specification states that the application's implementation of "HDPCVD to deposit intermetal dielectrics" is such that "it is generally not necessary to perform subsequent high temperature densification steps to densify the deposited dielectric material." The specification underlines this point by stating in the next sentence that "Use of HDPCVD processes desirably reduces the number of process steps" The clear meaning of this passage is that a high temperature step is avoided – not performed – in the preferred embodiments. That is the subject matter of claims 45 and 57.

The process described at page 12, line 26 to page 13, line 4 of the present application completes HDPCVD deposition of dielectric layer 38 and continues to form a PECVD oxide layer 40 on the dielectric layer 38, without an intervening high

temperature process. This is the simplified process referenced in the above-quoted portion of the application.

Applicants consequently submit that claims 45 and 57 are fully supported by the application and request that the written description rejection be withdrawn.

Section 103 Rejection

Applicants amend the independent claims to specify that the initial stage of the gap fill process is conducted so as to form layers of the dielectric material over the substrate, over the exposed side portions of the wiring lines and over at least portions of the remaining portions of the cap layer. This amendment finds support in FIG. 3 and in the application at page 12, lines 16-19. Conducting the HDPCVD process to have an initial stage that forms layers over the exposed side portions of the wiring lines protects the metal lines from subsequent portions of the HDPCVD gap fill process, which may use more energetic sputtering.

Specifically, claim 21 recites:

“depositing a dielectric material within the gaps at a sputtering rate sufficient to fill the gaps, using high density plasma chemical vapor deposition, the remaining portions of the cap layer in place at least during a time when the depositing begins, an initial stage of the depositing forming layers of the dielectric material over the substrate, over the exposed side portions of the wiring lines and over at least portions of the remaining portions of the cap layer.”

The cited art neither teaches nor suggests forming an initial uniform layer of dielectric over the exposed side portions of the metal lines.

The layer structure shown in FIG. 3 is not produced in the process of the JP 8-288285 publication. Rather, the '285 publication conducts its ECR oxide deposition throughout gap fill or through a substantial portion of fill using bias to provide directional fill so that the walls of the aluminum wiring in its examples would

not be covered. Specifically, the '285 publication describes filling the gaps between wiring lines using a sufficiently high sputtering component to remove the deposited oxide from the sides of its protection insulating film patterns 4a and from the sides of the openings in the metal layer. See Translation at ¶¶ 33, 42 and FIGS. 4, 5 and 9 (showing the preferred tapered cross section of protection insulating film 4a created by sputtering during oxide deposition). This stands in contrast to the invention of claim 21, which provides a greater process margin and greater protection to the metal wiring lines than does the process of the '285 publication. The '285 publication describes a fundamentally different process in which sputtering is used to continuously remove the initial portion of the dielectric layer from the sides of the metal patterns so that the '285 publication does not form such a uniform layer of dielectric over the sides of the metal lines. Consequently, claim 21 and its dependent claims distinguish over the '285 publication and the other references of record.

The Tobben patent does not describe anything of relevance to this aspect of the '285 publication and does not address the deficiencies of the '285 publication. Paragraph 5 of the final Office Action states that the Tobben patent teaches that it was known at the time of the invention to include a wiring line layer, a conductive protective layer (e.g., titanium nitride) and a cap layer. That is not true. The planarization layer 16 used in the Tobben patent's method must be non-conformal to perform its planarization function and it necessarily has widely varying thicknesses. The planarization layer 16 of the Tobben patent therefore cannot act as the cap layer defined in the pending claims, because that cap layer is identified as being a hard mask. to be effective, a hard mask cannot have the widely varying thicknesses that the Tobben patent requires of planarization layer 16. As such, the Tobben patent does not support the obviousness of the combination set out in the final Office Action and, for this additional reason, the claims distinguish over the references cited by the Office Action.

Consequently, claim 21 and its dependent claims distinguish over the art of record and are in condition for allowance.

Applicants note that new claim 58 finds support in FIG. 3 of the application.

Claim 35 and its dependent claims recite “an initial stage of the depositing forming layers of the dielectric material over the substrate, over the exposed side portions of the wiring lines and over at least portions of the remaining portion of the cap layer.” As discussed above, this process is neither taught nor suggested by the art of record and so claim 35 and its dependent claims distinguish over the art of record and are in condition for allowance.

Claim 40 and its dependent claims recite “depositing a dielectric material in an initial stage process to form layers of the dielectric material over the substrate and over the exposed side portions of the wiring lines and over at least portions of the remaining portion of the cap layer, the depositing continuing after the initial stage at a sufficiently high etch to deposition ratio to fill the gaps using a high density plasma chemical vapor deposition (HDPCVD) process.” As discussed above, this process is neither taught nor suggested by the art of record and so claim 40 and its dependent claims distinguish over the art of record and are in condition for allowance.

Response to Other Comments in the final Office Action

At the bottom of page 3 in discussing claim 26 and claim 42, the Office Action suggests that the shapes defined in claims 26 and 42 are inherent to the HDPCVD process. Applicants submit that these shapes are not inherent to the HDPCVD process, which can be conducted at wide ranging and varying process conditions. More to the point, the application describes forming these cross sections of the remaining portions of the cap layer prior to HDPCVD in a separate etching process. See FIGS. 5-8, application at page 13. Applicant amends claims 24-27, 40 and 42 to emphasize this point. Each of claims 24-27, 40 and 42 thus further distinguish

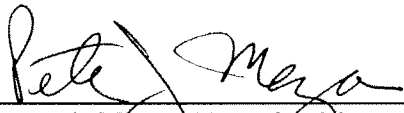
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over the cited art by reciting the shaping of the cap layer prior to the gap fill or HDPCVD.

Please charge deposit account no. 50-1123 \$910 to cover the cost of filing a Request for Continued Examination and Petition for One Month Extension of Time. If any additional fees are due in connection with the filing of this response, please charge the fees to our Deposit Account No. 50-1123.

Respectfully submitted,

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